The Papua New Guinea University of Technology

DEPARTMENT OF MINING ENGINEERING

2021 SECOND SEMESTER EXAMINATION

Second Year Mineral Process Engineering

MN211 – INTRODUCTION TO MINERALS ENGINEERING

DATE: MONDAY 1st NOVEMBER, 2021

TIME: 12:50 P.M

TIME ALLOWED: 3 HOURS

INFORMATION FOR CANDIDATES:

1. You have ten minutes to read this question paper. You **SHOULD NOT** begin writing during this period.

2. **There are THREE SECTIONS altogether (Section A; Geology, Section B; Mining and Section C; Mineral Processing). Answer all questions.**

3. **ALL** answers must be provided on the answer book provided. No other written material will be accepted.

4. Write your **NAME** and **NUMBER** clearly on the **ANSWER BOOK**. Do this **NOW**.

SECTION A. GEOLOGY (35 marks)

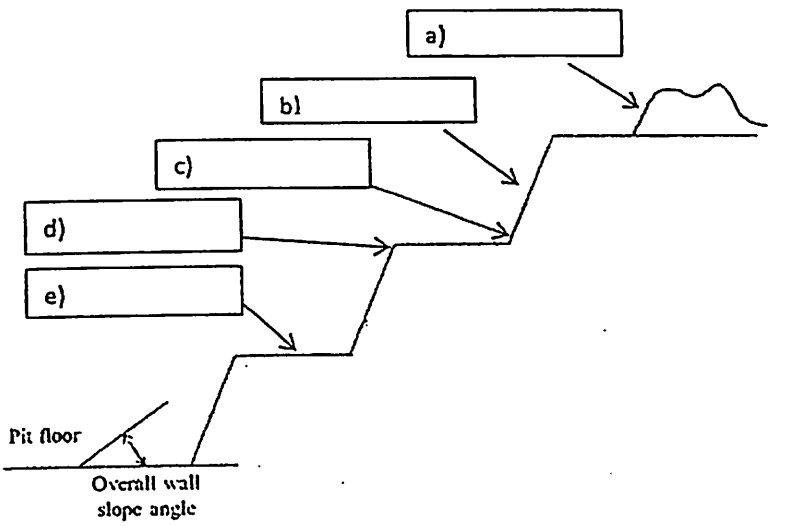
1. What is the accepted age of the universe where our solar system is part of? **(1 mark)**
2. Name two (2) dominant elements that make up the earth's crust. **(2 marks)**
3. List two (2) types of body waves generated from an earthquake? **(2 marks)**
4. Explain theory of plate tectonics. **(3 marks)**
5. Name five (5) major tectonic plates. **(5 marks)**
6. The lithosphere consists of .....and ..... **(2 marks)**
7. What produces the earth's magnetic field? **(2 marks)**
8. Name four (4) types of plate margins. **(4 marks)**
9. Name three (3) metals that occur in pure elemental form. **(3 marks)**
10. Name at least three (3) of the five types of Placer deposits. **(3 marks)**
11. List at least four (4) exploration methods used in mineral exploration. **(4 marks)**
12. Name the four main compositional groups where igneous rocks are divided into. **(4 marks)**

SECTION B: MINING

QUESTION 1: (7 marks)

I. In an open pit mine, there are different names of the profile of the pit. The diagram below captures a section view of a mine.

Fill in the blanks (a –e) with the correct names. (2 marks)



II. Compare and explain briefly so as to distinguish between the following Underground mining terms: (2marks)

- **Draw-point and Ore-pass**
- **Cross-cut and Drift**

III. Compare and explain briefly so as to distinguish between the following drill and blast terms used in both open-pit and underground mining: (3 marks)

- **Burden and Spacing**
- **Detonator and Booster**
- **Bulk Explosives and Packaged Explosives**

QUESTION 2: (5 marks)

Compare and explain briefly with the of aid a **neat sketch** the **difference** between **Cut-and-Fill Stoping** and **Shrinkage Stoping** underground mining methods. (5 marks)

QUESTION 3: (10 marks)

The following data were provided from mine planning to determine the different stripping ratio:

- Waste Stripping Cost: $ 25/t of waste
- Ore Production Cost: $ 150/t of ore
- Gold Price: $ 1300 /oz
- Mill Recovery: 85 %
- Gold Grade: 6.5 g/t

Bench	Ore tonnes (t)	Waste tonnes (t)
1	6, 500	4, 600
2	13, 000	29, 000
3	19, 500	60, 000
4	26, 000	140, 000
5	39, 000	165, 000

I. Determine which bench will be the pit limit on the prevailing economic conditions and briefly explain why. Show all calculations to attain full marks. (4 marks)

II. Calculate the **break-even cutoff grade** (BECOG) for **bench (#1)** and **bench (#2)** when given 6 % inflation and 2% royalty. (4 marks)

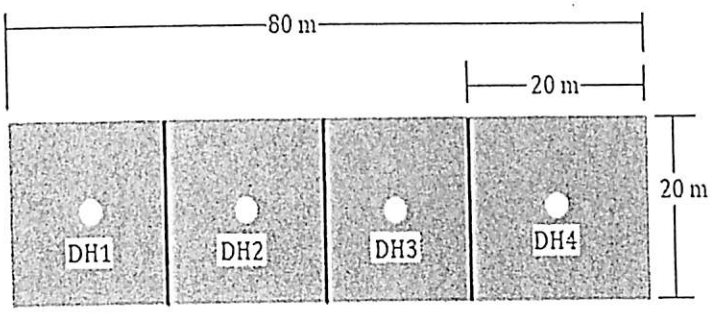
III. Two factors that significantly affect stripping ratio are **price of commodity** and **ore grade.** Explain how each affect the stripping ratio with the help of a neat sketch. (2 marks)

QUESTION 4: (8 marks)

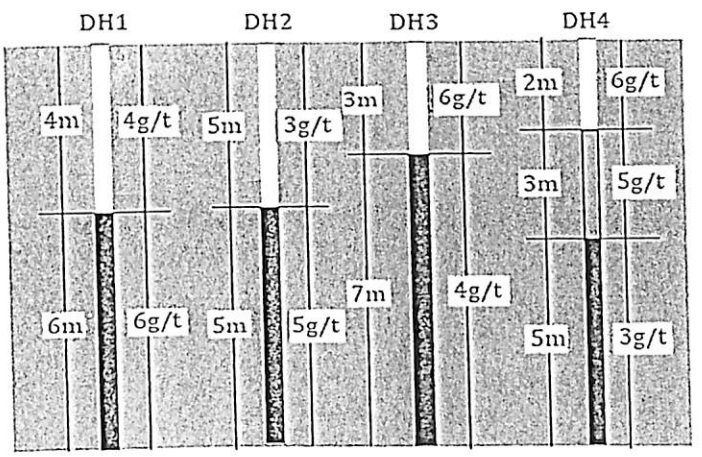
An ore block in the surface mining operation was planned and scheduled to be mined. The block tonnage and grade is required for grade control purposes.

Given information:

Four evenly spaced diamond drill-holes intersect the ore block. Given the dimension of the block: 20m (width), 80 m (length) and 20 m (height). The rock density is 2.7 t/m^3. Ore block dimensions are indicated on the figures provided.



Plan View



Long-sectional View

(Note//: Not to scale, sketch only - DH - Drill hole)

i) Calculate the designed tonnes and grade of the whole ore-block. (4 marks)

ii) Calculate the mined tonnes and grade when given 20 % dilution at 1.6 g/t and mine recovery of 85%. (4 marks)

Section C – Mineral Processing

Question one.

In mineral processing, crushing operations are the first stage of size reduction and are normally carried out in closed circuit with a screen. Crushing can be carried out in two or three stages depending on the size of the operation.

a) Briefly discuss the **three primary crushers** commonly used and their operating principles. Illustrate your answers with the appropriate diagrams if necessary.

b) What is the main purpose of screening and the factors affecting the screening process, briefly discuss them.

Question two.

Grinding is the final stage of size reduction in any given mineral processing operations. Explain the following features you may come across in a grinding unit operation.

a) Tumbling or grinding mills are classified into four distinct types, briefly describe them and outline their special features.

b) The speed of the mill is very important, it affects mill critical speed and the tumbling motion; please discuss critical speed and tumbling motion.

c) What are the functions of a mill liner?

d) Explain circulation load in a grinding mill.